Avaya Solution & Interoperability Test Lab

Application Notes for Brocade FastIron SuperX and GS Switches with an Avaya Telephony Infrastructure using Avaya Communication Manager in a Converged VoIP and Data Network - Issue 1.0

Abstract

These Application Notes describe the configuration of a Voice over IP (VoIP) solution consisting of Brocade FastIron SuperX and GS Switches with an Avaya Telephony Infrastructure using Avaya Communication Manager in a Converged VoIP and Data Network. Emphasis was placed on verifying the prioritization of VoIP traffic and voice quality in a converged VoIP and Data network scenario.

Information in these Application Notes has been obtained through DevConnect compliance testing and additional technical discussions. Testing was conducted via the DevConnect Program at the Avaya Solution and Interoperability Test Lab.

1. Introduction

These Application Notes describe the configuration of a Voice over IP (VoIP) solution using Brocade FastIron SuperX and GS Switches with an Avaya Telephony Infrastructure consisting of Avaya Communication Manager, Avaya SIP Enablement Services (SES), Avaya Modular Messaging, Avaya IA 770 INTUITY AUDIX and Avaya IP telephones. Compliance testing emphasis was placed on verifying the prioritization of VoIP traffic and voice quality in a converged VoIP and Data network scenario. Quality of Service (QoS) based on Layer 2 Priority (802.1p) and Layer 3 Differentiated Services (DiffServ) was implemented across the network to prioritize voice traffic over the LAN. The Avaya IP telephones get QoS priority settings from Avaya Communication Manager and are enforced in the network by the Brocade Switches. To verify VoIP traffic was given priority over data traffic, tests were performed by over-subscribing the LAN interfaces with low priority data traffic and verifying that acceptable voice quality was achieved when calls were routed over all of the LAN interfaces. Compliance testing included testing QoS, throughput, link aggregation, rapid spanning tree, load balancing, Open Shortest Path First (OSPF), and Direct IP Media connectivity while using G.711 and G.729 codecs.

1.1. Interoperability Compliance Testing

Interoperability compliance testing covered feature functionality, serviceability, and performance testing.

QoS testing verified that when the Brocade Switch interfaces are over subscribed with low priority data traffic, the higher priority VoIP media and signaling traffic still got through and achieved good voice quality. Prioritization of voice traffic was achieved by implementing Layer 3 DiffServ-based QoS and Layer 2 priority (801.p). Voice and data traffic were segmented in the enterprise network using VLANs. At the end of the performance test, it was verified that the network devices continued to operate successfully.

The telephony features verified to operate correctly included attended/unattended transfer, conference call participation, conference call add/drop, multiple call appearances, caller ID operation, call forwarding unconditional, call forwarding on busy, call Park, call pick-up, bridged call appearances, voicemail using Avaya Modular Messaging and Avaya IA770 INTUITY AUDIX, Message Waiting Indicator (MWI), and hold and return from hold.

Serviceability testing was conducted to verify the ability of the Avaya/Brocade VoIP solution to recover from adverse conditions, such as power cycling network devices and disconnecting cables between the LAN interfaces. In all cases, the ability to recover after the network normalized was verified.

1.2. Support

Phone Support:

US: 1-877-887-2622

International: 408-207-1600

Email support: support@foundrynet.com

www.brocade.com/services-support/index.page

2. Reference Configuration

The configuration in **Figure 1** shows a single site converged VoIP and data network with multiple closets and labs configured with link aggregation, rapid spanning tree, load balancing and OSPF.

For compliance testing, a centralized corporate DHCP server was used. To better manage the different traffic types, the voice and data traffic were separated onto different VLANs.

2.1. Control Room

The control room consisted of a Brocade FastIron SuperX Switch, Avaya Communication Manager running on an Avaya S8300 Server with an Avaya G450 Media Gateway, Avaya SES, Avaya Modular Messaging, Avaya IA 770 INTUITY AUDIX, one Avaya 2400 Series Digital Telephone, one Avaya 9630G IP Telephone running Avaya one-X Deskphone Edition on VLAN Voice1, one Avaya 9620 IP Telephone running Avaya one-X Deskphone SIP on VLAN Voice1 and one Corporate DHCP/File server. The corporate site provided a DHCP/File server for assigning IP network parameters and to download settings to the Avaya IP telephones. The Brocade FastIron SuperX Switch supplied Power over Ethernet (PoE) power for the Avaya IP telephones and was configured to support link aggregation, rapid spanning tree, load balancing, VLANs, enforce QoS policies, and OSPF with the peer Brocade switches.

2.2. Lab-A

Lab-A consisted of a Brocade FastIron GS Switch, one Avaya 9630 IP Telephone running Avaya one-X Deskphone Edition and one Avaya 9620 IP Telephone running Avaya one-X Deskphone SIP on VLAN Voice2 and a PC on Datavlan2. The Brocade FastIron GS Switch supplied PoE power for the Avaya IP telephones and was configured to support link aggregation, rapid spanning tree, load balancing, VLANs, enforce QoS policies, and OSPF with the peer Brocade switches.

2.3. Closet-A

Closet-A consisted of a Brocade FastIron GS Switch. It was configured to support VLANs, rapid spanning tree and enforce QoS policies.

2.4. Closet-B

Closet-B consisted of a Brocade FastIron GS Switch, one Avaya 9620 IP Telephone running Avaya one-X Deskphone SIP and one Avaya 9630G IP Telephone running Avaya one-X Deskphone Edition on VLAN Voice1 and a PC on VLAN Datavlan1. The FastIron GS Switch supplied PoE power for the Avaya IP telephones and was configured to support link aggregation, rapid spanning tree, enforce QoS policies, and load balancing.

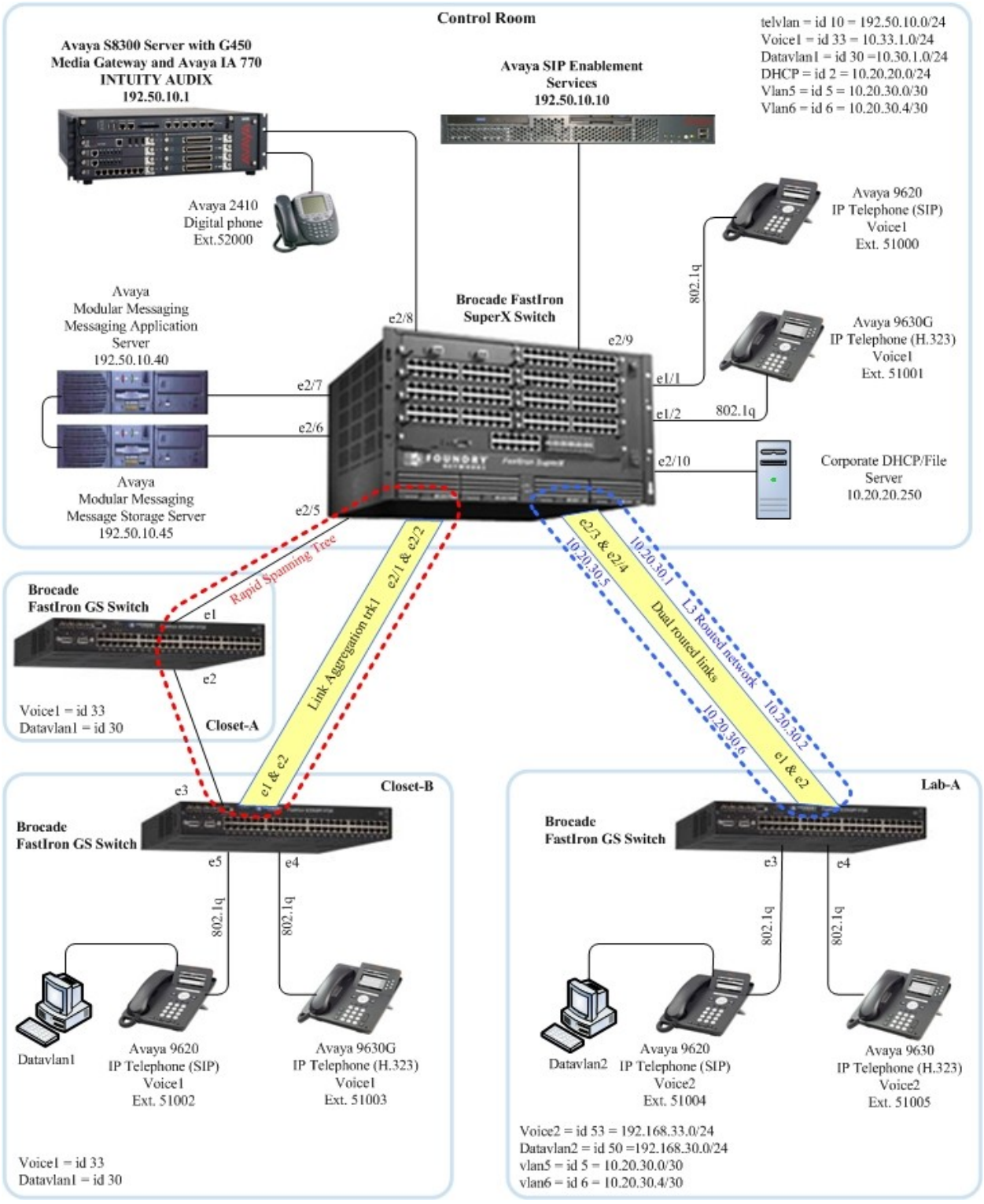

Figure 1: Avaya/Brocade Network Diagram

3. Equipment and Software Validated

The following equipment and software were used for the sample configuration provided:

Equipment	Software/Firmware
Avaya PBX Products	
Avaya S8300 Server running Avaya Communication Manager	Avaya Communication Manager 5.1.2
Avaya G450 Media Gateway MGP MM712 DCP Media Module Avaya IA 770 INTUITY AUDIX	 28.22.0 HW9 5.1.2
Avaya SIP Enablement Services (SES)	
Avaya SIP Enabled Services (SES) Server	5.1.2
Avaya Messaging (Voice Mail) Products	
Avaya Modular Messaging - Messaging Application Server (MAS)	4.0
Avaya Modular Messaging - Message Storage Server (MSS)	4.0
Avaya IA 770 INTUITY AUDIX	5.1
Avaya Telephony Sets	
Avaya 9600 Series IP Telephones	Avaya one-X Deskphone Edition 3.0
Avaya 9600 Series IP Telephones	Avaya one-X Deskphone SIP 2.0.0
Avaya 2410 Digital Telephone	5.0
Brocade Products	
Brocade FastIron SuperX Switch	05.0.00T3e3
Brocade FastIron GS Switch with routing enabled	04.3.01T7e3
Brocade FastIron GS Switch	04.3.01T7e1
MS Products	
Microsoft Windows 2003 Server	File/DHCP Service

4. Configure Avaya Communication Manager

This section shows the steps used to configure Avaya Communication Manager. For detailed information on the installation, maintenance, and configuration of Avaya Communication Manager, refer to **[1]**.

IP networks were originally designed to carry data on a best-effort delivery basis, which meant that all traffic had equal priority and an equal chance of being delivered in a timely manner. As a result, all traffic had an equal chance of being dropped when congestion occurred. QoS is now utilized to prioritize VoIP traffic and should be implemented throughout the entire network.

In order to achieve prioritization of VoIP traffic, the VoIP traffic must be classified. The Avaya S8300 Server, Avaya G450 Media Gateway, Avaya SIP Enablement Services and Avaya IP telephones support both 802.1p and DiffServ.

All network components are in network region 1 for this sample configuration. The DiffServ and 802.1p/Q values configured here will be downloaded to the Avaya H.323 IP Telephones via Avaya Communication Manager. Avaya SIP IP Telephones will get QoS settings by downloading the 46xxsettings file from the HTTP server. For more information on QoS settings please refer to **[1]**.

Use the **change ip-network-region 1** command to change the DIFFSERV/TOS PARAMETERS and 802.1P/Q PARAMETERS settings configured in Avaya Communication Manager.

```
change ip-network-region 1                                    Page   1 of  19
                            IP NETWORK REGION
  Region: 1
Location:         Authoritative Domain: devcon.com
    Name:
MEDIA PARAMETERS                Intra-region IP-IP Direct Audio: yes
      Codec Set: 1              Inter-region IP-IP Direct Audio: yes
   UDP Port Min: 2048                     IP Audio Hairpinning? y
   UDP Port Max: 3027
DIFFSERV/TOS PARAMETERS                 RTCP Reporting Enabled? y
 Call Control PHB Value: 48      RTCP MONITOR SERVER PARAMETERS
        Audio PHB Value: 48       Use Default Server Parameters? y
        Video PHB Value: 26
802.1P/Q PARAMETERS
 Call Control 802.1p Priority: 6
        Audio 802.1p Priority: 6
        Video 802.1p Priority: 5      AUDIO RESOURCE RESERVATION PARAMETERS
H.323 IP ENDPOINTS                                       RSVP Enabled? n
  H.323 Link Bounce Recovery? y
 Idle Traffic Interval (sec): 20
   Keep-Alive Interval (sec): 5
            Keep-Alive Count: 5
```

The Differentiated Services Code Point (DSCP) value of 48 will be used for both PHB values. DSCP 48 represents the traffic class of premium and the traffic type voice. Set the **Call Control PHB Value** to **48** and the **Audio PHB Value** to **48**. **Call Control 802.1p Priority** and **Audio 802.1p Priority** are set to **6**.

5. Configure the Brocade Networks FastIron SuperX Switch in Control Room

This section addresses how to configure the Brocade FastIron SuperX Switch. The Brocade FastIron SuperX Switch was used as the core Layer 2/Layer 3 router and will enforce QoS policies supporting Link Aggregation, OSPF and spanning tree.

To configure the FastIron SuperX Switch, connect a PC or laptop to the serial port of the FastIron SuperX Switch. Run a terminal emulation program with the following configuration:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow Control: None

1. Log into Brocade FastIron SuperX Switch.

Connect to the Brocade FastIron SuperX Switch. Log in using the appropriate credentials. Login: Password: FastIron SuperX Switch#

2. Enable the following features on the FastIron SuperX Switch.
   - Change the hostname
   - Enable global spanning tree
   - Create link aggregation trunk
   - Enable Rapid Spanning Tree admin-pt2pt-mac for uplink to other switches
   - Enable QoS
   - Set QoS Differentiated Services information
   - Create QoS access lists
   - Enable OSPF and set area
   - Enable Rapid Spanning Tree to ports

```
FastIron SuperX Switch# config t
FastIron SuperX Switch(config)# hostname Control_Room
Control_Room(config)# global-stp
Control_Room(config)# int eth 2/1
Control_Room(config-if-e1000-2/1)#link-aggregate configure key 11500
Control_Room(config-if-e1000-2/1)#link-aggregate active
Control_Room(config-if-e1000-2/1)#spanning-tree 802-1w admin-pt2pt-mac
Control_Room(config)#int eth 2/2
Control_Room(config-if-e1000-2/2)#link-aggregate configure key 11500
Control_Room(config-if-e1000-2/2)#link-aggregate active
Control_Room(config)#qos mechanism strict
Control_Room(config)#qos-tos map dscp-priority 46 48 to 7
Control_Room(config)#qos-tos map dscp-priority 0 to 1
Control_Room(config)# access-list 101 permit ip any any dscp-matching 46  802.1p-
priority-marking 7 internal-priority-marking 7
Control_Room(config)# access-list 101 permit ip any any dscp-matching 48  802.1p-
priority-marking 7 internal-priority-marking 7
Control_Room(config)# access-list 101 permit ip any any dscp-matching 0 dscp-cos-
mapping
Control_Room(config)# access-list 101 permit ip any any
Control_Room(config)# router ospf
Control_Room(config-ospf-router)# area 10
Control_Room(config-ospf-router) exit
Control_Room(config)# int eth 2/5
Control_Room(config-if-2/5)# spanning-tree 802-1w admin-pt2pt-mac
```

3. Write the running configuration to the startup configuration.

```
Control_Room(config)# write memory
```

4. Create and configure dual routed links to Lab-A.

- Assign a VLAN ID for interface Ethernet 2/3
- Assign a port to vlan 5
- Enable Rapid Spanning Tree and assign priority 0
- Create interface and assign an IP address for virtual interface 5
- Add the Virtual Interface to OSPF area 10
- Add the Virtual Interface to access list 101
- Assign a VLAN ID for interface Ethernet 2/4
- Assign a port to vlan 6
- Enable Rapid Spanning Tree and assign priority 0
- Create interface and assign an IP address for virtual interface 6
- Add the Virtual Interface to OSPF area 10
- Add the Virtual Interface to access list 101

```
Control_Room(config)# # config t
Control_Room(config)# vlan 5
Control_Room(config-vlan-5)# tagged eth 2/3
Control_Room(config-vlan-5)# spanning-tree 802-1w
Control_Room(config-vlan-5)# spanning-tree 802-1w priority 0
Control_Room(config-vlan-5)# router-interface ve 5
Control_Room(config-vlan-5)# int ve 5
Control_Room(config-if-ve5)# ip address 10.20.30.5 255.255.255.252
Control_Room(config-if-ve5)# ip ospf area 10
Control_Room(config-if-ve5)# ip access-group 101 in
Control_Room(config-if-ve5)# exit
Control_Room(config)# vlan 6
Control_Room(config-vlan-6)# tagged eth 2/4
Control_Room(config-vlan-6)# spanning-tree 802-1w
Control_Room(config-vlan-6)# spanning-tree 802-1w priority 0
Control_Room(config-vlan-6)# router-interface ve 6
Control_Room(config-if-ve6)# int eth 2/4
Control_Room(config-if-ve6)# ip address 10.20.30.1 255.255.255.252
Control_Room(config-if-ve6)# ip ospf area 10
Control_Room(config-if-ve6)# ip access-group 101 in
Control_Room(config-if-ve6)# exit
```

5. Create and configure the telephony VLAN that all of the Avaya telephony equipment will run on.

   - Assign a VLAN ID 10 for the telephony VLAN
   - Assign ports to the telephony VLAN
   - Enable Rapid Spanning Tree and assign priority 0
   - Create the interface and assign an IP address for the virtual interface 10
   - Add VLAN to access-group
   - Add a helper-address for the telephony VLAN
   - Add the VLAN to OSPF area 10

```
Control_Room# config t
Control_Room(config)# vlan 10
Control_Room(config-vlan-10)# tagged eth 2/1 to 2/2 eth 2/5
Control_Room(config-vlan-10)# untagged eth 2/6 to 2/9
Control_Room(config-vlan-10)# spanning-tree 802-1w
Control_Room(config-vlan-10)# spanning-tree 802-1w priority 0
Control_Room(config-vlan-10)# router-interface ve 10
Control_Room(config-vif-10) # ip address 192.50.10.254/24
Control_Room(config-vif-10) # ip access-group 101 in
Control_Room(config-vif-10) # ip helper-address 1 10.20.20.250
Control_Room(config-vif-10) # ip ospf area 10
Control_Room(config-vif-10) # exit
```

6. Create and configure the voice VLAN that will run between the control room and closets.

- Assign a VLAN ID 33 for the voice VLAN
- Assign ports to the voice1 VLAN
- Enable Rapid Spanning Tree and assign priority 0
- Create the virtual interface and assign an IP address for the virtual interface 33
- Add VLAN to access-group
- Add a helper-address for the voice1 VLAN
- Add the VLAN to OSPF area 10

```
Control_Room # config t
Control_Room(config)# vlan 33
Control_Room(config-vlan-33)# tagged eth 1/1 to 1/2 eth 2/1 to 2/2 eth 2/5
Control_Room(config-vlan-33)# spanning-tree 802-1w
Control_Room(config-vlan-33)# spanning-tree 802-1w priority 0
Control_Room(config-vlan-33)# router-interface ve 33
Control_Room(config-vlan-33)#int ve 33
Control_Room(config-vif-33)# ip address 10.33.1.254/24
Control_Room(config-vif-33)# ip access-group 101 in
Control_Room(config-vif-33)# ip helper-address 1 10.20.20.250
Control_Room(config-vif-33)# ip ospf area 10
Control_Room(config-vif-33)# ip ospf passive
Control_Room(config-vif-33) # exit
```

7. Create and configure the data VLAN that will run between the control room and closets.

- Assign a VLAN ID for the data1 VLAN
- Assign ports to the data VLAN
- Enable spanning tree and assign priority 0
- Create the interface and assign an IP address for the data VLAN
- Add a helper-address for the data VLAN
- Add the VLAN to OSPF area 10
- Place interface 1/1 & 1/2 in dual mode and disable spanning tree

```
Control_Room # config t
Control_Room(config)# vlan 30
Control_Room(config-vlan-30)# tagged eth 1/1 to 1/2 eth 2/1 to 2/2 eth 2/5
Control_Room(config-vlan-30)# spanning-tree 802-1w
Control_Room(config-vlan-30)# spanning-tree 802-1w priority 0
Control_Room(config-vlan-30)# router-interface ve 30
Control_Room(config-vlan-30)# int ve 30
Control_Room(config-vif-30) # ip address 10.30.1.254/24
Control_Room(config-vif-30) # ip helper-address 1 10.20.20.250
Control_Room(config-vif-30) # ip ospf area 10
Control_Room(config-vif-30) # ip ospf passive
Control_Room(config-vif-30) # exit
Control_Room(config)# int eth 1/1
Control_Room(config-if-1/1) dual-mode 30
Control_Room(config-if-1/1) no spanning-tree
Control_Room(config-if-1/1) exit
Control_Room(config)# int eth 1/2
Control_Room(config-if-1/2) dual-mode 30
Control_Room(config-if-1/1) no spanning-tree
Control_Room(config-if-1/2) exit
```

8. Create and configure the DHCP VLAN.

- Assign a VLAN ID for the DHCP VLAN
- Assign ports to the DHCP VLAN
- Enable spanning tree and assign priority 0
- Create the interface and assign an IP address for the DHCP VLAN
- Add the VLAN to OSPF area 10

```
Control_Room # config t
Control_Room(config)# vlan 2
Control_Room(config-vlan-2)# untagged eth 2/10
Control_Room(config-vlan-2)# spanning-tree 802-1w
Control_Room(config-vlan-2)# spanning-tree 802-1w priority 0
Control_Room(config-vlan-2)# router-interface ve 2
Control_Room(config-vif-2) # ip address 10.20.20.1/24
Control_Room(config-vif-2) # ip ospf area 10
Control_Room(config-vif-2) # exit
```

9. Write the running configuration to the startup configuration.

```
Control_Room(config)# write memory
```

6. Configure the Brocade Networks FastIron GS Switch in Lab-A

This section addresses how to configure the Brocade FastIron GS Switch. Brocade FastIron GS Switch will enforce QoS policies supporting link aggregation, OSPF and spanning tree.

To configure the FastIron GS Switch, connect a PC or laptop to the serial port of the FastIron GS Switch. Run a terminal emulation program with the following configuration:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow Control: None

1. Log into Brocade FastIron GS Switch.

Connect to the Brocade FastIron GS Switch. Log in using the appropriate credentials.

Login:
Password:
FastIron GS Switch#

2. Enable the following features on the FastIron GS Switch.

- Set the hostname of the switch
- Enable global spanning tree and turn on rapid spanning tree for VLAN1
- Enable QoS
- Set QoS Differentiated Services information
- Create QoS access list 101
- Enable OSPF and set area 10

FastIron GS Switch # **config t**
FastIron GS Switch(config)# **hostname Lab_A**
Lab_A(config)# **global-stp**
Lab_A(config)# **vlan 1**
Lab_A(config-vlan-1)# **spanning-tree 802-1w**
Lab_A(config-vlan-1)# **exit**
Lab_A(config)# **qos mechanism strict**
Lab_A(config)# **qos-tos map dscp-priority 46 48 to 7**
Lab_A(config)# **qos-tos map dscp-priority 0 to 1**
Lab_A(config)# **access-list 101 permit ip any any dscp-matching 48 802.1p-priority-marking 7**
Lab_A(config)# **access-list 101 permit ip any any dscp-matching 46 802.1p-priority-marking 7**
Lab_A(config)# **access-list 101 permit ip any any dscp-matching 0**
Lab_A(config)# **access-list 101 permit ip any any**
Lab_A(config)# **router ospf**
Lab_A(config-ospf-router)# **area 10**
Lab_A(config-ospf-router)# **exit**

3. Write the running configuration to the startup configuration.

Lab_A (config)# **write memory**

4. Create, configure and enable the dual routed links to Control Room.

- Assign a VLAN ID for interface 0/1/1
- Assign a port to vlan 5
- Create virtual interface and assign an IP address
- Add the virtual interface to OSPF area 10
- Apply the access list
- Turn spanning tree on
- Assign a VLAN ID for interface 0/1/2
- Assign a port to vlan 6
- Create interface and assign an IP address
- Add the virtual interface to OSPF area 10
- Apply the access list
- Turn spanning tree on

```
Lab_A # configure t
Lab_A (config)# vlan 5
Lab_A (config-vlan-5)# tagged eth 0/1/1
Lab_A (config-vlan-5)# router-interface ve5
Lab_A (config-vlan-5)# exit
Lab_A (config)# int ve 5
Lab_A (config-if-ve5)# ip address 10.20.30.6 255.255.255.252
Lab_A (config-if-ve5)# ip ospf area 10
Lab_A (config-if-ve5)# ip access-group 101 in
Lab_A (config-if-ve5)# spanning-tree 802-1w
Lab_A (config-if-ve5)# exit
Lab_A (config)# vlan 6
Lab_A (config-vlan-6)# tagged eth 0/1/2
Lab_A (config-vlan-6)# router-interface ve 6
Lab_A (config-vlan-6)# exit
Lab_A (config)# int eth ve 6
Lab_A (config-if-ve6)# ip address 10.20.30.2 255.255.255.252
Lab_A (config-if-ve6)# ip ospf area 10
Lab_A (config-if-ve6)# ip access-group 101 in
Lab_A (config-if-ve6)# spanning-tree 802-1w
Lab_A (config-if-ve6)# exit
```

5. Create and configure the voice VLAN for Lab-A.

- Assign a VLAN ID for the voice VLAN
- Assign ports to the voice VLAN
- Create the virtual interface and assign an IP address for the voice VLAN
- Add a helper-address for the voice VLAN
- Add the Virtual Interface to OSPF area 10
- Add the Virtual Interface to access list 101

```
Lab_A # config t
Lab_A (config)# vlan 53
Lab_A (config-vlan-53)# tagged eth 0/1/3 to 0/1/4
Lab_A (config)-vlan-53)# router-interface ve 53
Lab_A (config)-vlan-53)# int ve 53
Lab_A (config-vif-53) # ip address 192.168.33.254/24
Lab_A (config-vif-53) # ip helper-address 1 10.20.20.250
Lab_A (config-vif-53) # ip ospf area 10
Lab_A (config-vif-53) # ip ospf passive
Lab_A (config-vif-53) # ip access-group 101 in
Lab_A (config-vif-53) # exit
```

6. Create and configure the data VLAN for Lab-A.

- Assign a VLAN ID for the data VLAN
- Assign ports to the data VLAN
- Create the virtual interface and assign an IP address for the data VLAN
- Add a helper-address for the data VLAN
- Add the VLAN to OSPF area 10
- Apply access list 101

```
Lab_A # config t
Lab_A (config)# vlan 50
Lab_A (config-vlan-50)# tagged eth 0/1/3 to 0/1/4
Lab_A (config-vlan-50)# router-interface ve 50
Lab_A (config-vlan-50)# int ve 50
Lab_A (config-vif-50) # ip address 192.168.30.254/24
Lab_A (config-vif-50) # ip helper-address 1 10.20.20.250
Lab_A (config-vif-50) # ip ospf area 10
Lab_A (config-vif-50) # ip ospf passive
Lab_A (config-vif-50) # ip access-group 101 in
Lab_A (config-vif-50) # exit
```

7. Configure ports for phones
   - Enable dual mode trunking on ports 0/1/3 and 0/1/4
   - Turn on inline power
   - Enable DCSP on the virtual interface
   - Disable spanning tree on the interface

```
Lab_A (config)# int eth 0/1/3
Lab_A (config-if-0/1/3)# dual-mode 50
Lab_A (config-if-0/1/3)# inline power
Lab_A (config-if-0/1/3)# trust dcsp
Lab_A (config-if-0/1/3)# no spanning-tree
Lab_A (config)# int eth 0/1/4
Lab_A (config-if-0/1/4)# dual-mode 50
Lab_A (config-if-0/1/4)# inline power
Lab_A (config-if-0/1/4)# trust dcsp
Lab_A (config-if-0/1/4)# no spanning-tree
```

8. Write the running configuration to the startup configuration.

```
Lab_A (config)# write memory
```

7. Configure the Brocade Networks FastIron GS Switch in Closet-B

This section addresses how to configure the Brocade FastIron GS Switch. Brocade FastIron GS Switch was used as the core Layer 2 switch and will enforce QoS policies supporting link aggregation and spanning tree.

To configure the FastIron GS Switch, connect a PC or laptop to the serial port of the FastIron GS Switch. Run a terminal emulation program with the following configuration:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow Control: None

1. Log into Brocade FastIron GS Switch.

Connect to the Brocade FastIron GS Switch. Log in using the appropriate credentials. Login: Password: FastIron GS Switch#

2. Enable the following features on the FastIron GS Switch.

- Set the hostname of the switch
- Create link aggregation trunk for ports 0/1/1 & 0/1/2
- Enable spanning-tree for direct uplink switch ports
- Enable QoS
- Set QoS Differentiated Services information
- Create QoS access list 101
- Write memory

```
FastIron GS Switch # config t
FastIron GS Switch # hostname Closet_B
Closet_B(config)# int eth 0/1/1
Closet_B (config-if-0/1/1)# link-aggregate configure key 11500
Closet_B (config-if-0/1/1)# link-aggregate active
Closet_B (config-if-0/1/1)# spanning-tree 802-1w admin-pt2pt-mac
Closet_B(config)# int eth 0/1/2
Closet_B (config-if-0/1/2)# link-aggregate configure key 11500
Closet_B (config-if-0/1/2)# link-aggregate active
Closet_B (config-if-0/1/2)# spanning-tree 802-1w admin-pt2pt-mac
Closet_B (config-if-0/1/2)# exit
Closet_B (config)# int eth 0/1/3
Closet_B (config-if-0/1/3)# spanning-tree 802-1w admin-pt2pt-mac
Closet_B (config)# qos mechanism strict
Closet_B (config)# qos-tos map dscp-priority 48 46 to 7
Closet_B (config)# qos-tos map dscp-priority 0 to 1
Closet_B (config)# access-list 101 permit ip any any dscp-matching 46 priority-marking 7
Closet_B (config)# access-list 101 permit ip any any dscp-matching 48 priority-marking 7
Closet_B (config)# access-list 101 permit ip any any dscp-matching 0
Closet_B (config)# access-list 101 permit ip any any
Closet_B (config-if-0/1/1)# write memory
```

3. Create and configure the voice VLAN that will run between the control room and closets.

- Assign VLAN ID 33 for the voice VLAN
- Enable spanning-tree
- Add ports to voice VLAN

```
Closet_B # config t
Closet_B (config)# vlan 33
Closet_B (config-vlan-33)# spanning-tree 802-1w
Closet_B (config-vlan-33)# tagged eth 0/1/1 to 0/1/5
Closet_B (config-vlan-33)# exit
```

4. Create and configure the data VLAN that will run between the control room and closets.

- Assign a VLAN ID 30 for the data VLAN
- Enable spanning-tree
- Assign ports to the data VLAN

```
Closet_B # config t
Closet_B (config)# vlan 30
Closet_B (config-vlan-30)# spanning-tree 802-1w
Closet_B (config-vlan-30)# tagged eth 0/1/1 to 0/1/5
Closet_B (config-vlan-30 # exit
```

5. Assign ports to VLAN 30

- Enable dual mode trunking on ports 0/1/4 and 0/1/5
- Apply Access List 101
- Turn on inline power
- Enable DCSP
- Disable spanning tree on the interface

```
Closet_B (config)# int eth 0/1/4
Closet_B (config-if-0/1/4)# dual-mode 30
Closet_B (config-if-0/1/4)# ip access-group 101 in
Closet_B (config-if-0/1/4)# inline power
Closet_B (config-if-0/1/4)# trust dscp
Closet_B (config-if-0/1/4)# no spanning-tree
Closet_B (config-if-0/1/4)# exit
Closet_B (config)# int eth 0/1/5
Closet_B (config-if-0/1/5)# dual-mode 30
Closet_B (config-if-0/1/5)# ip access-group 101 in
Closet_B (config-if-0/1/5)# inline power
Closet_B (config-if-0/1/5)# trust dscp
Closet_B (config-if-0/1/5)# no spanning-tree
Closet_B (config-if-0/1/5)# exit
```

6. Write the running configuration to the startup configuration

```
Closet_B (config)# write memory
```

8. Configure the Brocade Networks FastIron GS Switch in Closet-A

This section addresses how to configure the Brocade FastIron GS Switch. The Brocade FastIron GS Switch will enforce QoS policies and spanning tree.

To configure the FastIron GS Switch, connect a PC or laptop to the serial port of the FastIron GS Switch. Run a terminal emulation program with the following configuration:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow Control: None

1. Log into Brocade FastIron GS Switch.

Connect to the Brocade FastIron GS Switch. Log in using the appropriate credentials. Login: Password: FastIron GS Switch#

2. Enable the following features on the FastIron GS Switch.

- Configure Hostname
- Enable QoS
- Set QoS Differentiated Services information
- Create QoS access list 101
- Add ports to access list
- Enable Rapid Spanning Tree admin-pt2pt-mac for uplink to other switches
- Write the running configuration to the startup configuration

```
FastIron GS Switch # config t
FastIron GS Switch(config) # hostname Closet_A
Closet_A(config)# qos mechanism strict
Closet_A(config)# qos-tos map dscp-priority 46 48 to 7
Closet_A(config)# qos-tos map dscp-priority 0 to 1
Closet_A(config)# access-list 101 permit ip any any dscp-matching 46 802.1p-priority-marking 7
Closet_A(config)# access-list 101 permit ip any any dscp-matching 48 802.1p-priority-marking 7
Closet_A(config)# access-list 101 permit ip any any dscp-matching 0
Closet_A(config)# access-list 101 permit ip any any
Closet_A(config)# int eth 0/1/1
Closet_A(config)#  ip access-group 101 in
Closet_A(config)#  spanning-tree 802-1w admin-pt2pt-mac
Closet_A(config)# int eth 0/1/2
Closet_A(config)#  ip access-group 101 in
Closet_A(config)#  spanning-tree 802-1w admin-pt2pt-mac
Closet_A(config)# wr mem
```

3. Create and configure the voice VLAN for Closet-A.

- Assign a VLAN ID for the voice VLAN
- Assign ports to the voice VLAN
- Enable Spanning tree on the VLAN

```
Closet_A# config t
Closet_A(config)# vlan 33
Closet_A(config-vlan-33)# tagged eth 0/1/1 to 0/1/2
Closet_A(config-vlan-33)# spanning-tree 802-1w
Closet_A(config-vlan-33)# exit
```

4. Create and configure the data VLAN for Closet-A

- Assign a VLAN ID for the data VLAN
- Assign ports to the data VLAN
- Enable Spanning tree on the VLAN

```
Closet_A# config t
Closet_A(config)# vlan 30
Closet_A(config-vlan-30)# tagged eth 0/1/1 to 0/1/2
Closet_A(config-vlan-30)# spanning-tree 802-1w
Closet_A(config-vlan-30)# exit
```

5. Write the running configuration to the startup configuration

```
Closet_A(config)# write memory
```

9. General Test Approach and Test Results

9.1. Test Approach

All feature functionality test cases were performed manually. The general test approach entailed verifying the following:

- LAN connectivity between the Avaya and Brocade products
- Registration of Avaya H.323 IP telephones with Avaya Communication Manager
- Registration of Avaya SIP IP telephones with Avaya SIP Enablement Services
- Verification of the DHCP relay configuration
- VoIP calls over Layer 2 and Layer 3 connections
  Inter-office calls using G.711 mu-law & G.729 codecs
- Verifying that QoS directed the voice signaling and voice media to the higher priority egress queue based on the packets' DSCP value.
- Verifying that Avaya Modular Messaging voicemail and MWI work properly.
- Verifying that Avaya IA 770 INTUITY AUDIX voicemail and MWI work properly.
- Features Tested: attended/unattended transfer, conference call participation, conference call add/drop, multiple call appearances, caller ID operation, call forwarding unconditional, call forwarding on busy, call Park, call pick-up, bridged call appearances

The performance tests were performed by over subscribing the lines with low priority data and verifying that the prioritization of VoIP traffic and voice was achieved when calls are routed over all of the LAN interfaces.

9.2. Test Results

All feature functionality, serviceability, and performance test cases passed. The Brocade implementation did prioritization of VoIP traffic and yielded good voice quality with no calls being lost. The Avaya/Brocade solution was successfully verified through performance and serviceability testing.

10. Verification Steps

This section provides the steps for verifying end-to-end network connectivity and QoS in the field from the perspective of the Brocade FastIron SuperX Switch. In general, the verification steps include:

1. Verify the DHCP relay on the Brocade switches is functioning by confirming that the Avaya IP telephones receive their IP addresses from the DHCP server connected to the Brocade FastIron SuperX Switch.

2. Check that the Avaya IP telephones have successfully registered with Avaya Communication Manager using the **list registered-station** command.

3. Place internal and external calls between the digital telephone and IP telephones at each site.

11. Conclusion

These Application Notes describe the configuration steps for integrating Brocade Switches with an Avaya telephony infrastructure. For the configuration described in these Application Notes, the Brocade switches were responsible for enforcing QoS using Layer 3 Differentiated Services and Layer 2 (802.1p) as well as link aggregation, rapid spanning tree, load balancing and OSPF. Avaya Communication Manager delivered the voice traffic to the routers for transmission over the LAN together with data traffic. Prioritization of VoIP traffic and good voice quality was successfully achieved in the Avaya/Brocade configuration described herein.

12. Additional References

The documents referenced below were used for additional support and configuration information.

The following Avaya product documentation can be found at http://support.avaya.com.

[1] *Administrator Guide for Avaya Communication Manager, Document Number* 03-300509.
[2] *Installing and Administering SIP Enablement Services*, March 2007, Issue 2.1, Document Number 03-600768.
[3] *Avaya one-X Deskphone Edition for 9600 Series IP Telephones Administrator Guide Release 2.0,* Document Number 16-300698.
[4] *Avaya one-X Deskphone SIP for 9600 Series IP Telephones Installation and Maintenance Guide Release 2.0,* Document Number 16-601943.
[5] *Messaging Application Server (MAS) Administration Guide,* Release 3.1, February 2007.
[6] *Avaya IA 770 INTUITY AUDIX Messaging Application Release* 5.0 Administering. Communication Manager Servers to Work with IA 770 November 2007.

The Brocade product documentation can be found at: http://www.Brocadenet.com/.

[7] *Brocade FastIron Configuration Guide* with sections as follows:

- *FastIron X Series Chassis*
  - *FastIron SuperX*
- *FastIron Layer 2 Compact Switches*
  - *FastIron GS*

13. Change History

Issue	Date	Reason
1.0	4/28/2009	Initial issue

Please e-mail any questions or comments pertaining to these Application Notes along with the full title name and filename, located in the lower right corner, directly to the Avaya DevConnect Program at devconnect@avaya.com.